DOCUMENT RESUME

ED 313 242 SE 051 052

AUTHOR	Arbanas, Rose J.; Lindquist, Gayla R., Ed.
TITLE	Girls + Math + Science = Choices. A Handbook for Educators.
INSTITUTION	Calhoun Intermediate School District, Marshall, Mich.
SPONS AGENCY	Michigan State Board of Education, Lansing.
PUB DATE	89
NOTE	41p.; For related documents, see SE 051 051 and SE 051 055.
AVAILABLE FROM	Calhoun Intermediate School District, 17111 G Drive North, Marshall, MI 49068 ($2.50 plus $1.50 postage. For more than one, additional postage will be charged).
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Career Education; *Career Guidance; *Females; Mathematics Education; Program Guides; *Science Careers; Science Materials; Scientific Personnel; Secondary Education; Secondary School Mathematics; Secondary School Science; *Sex Bias; Sex Stereotypes

ABSTRACT

This is a handbook for educators. It is intended to stimulate interest in career choices for young women in mathematics and science related areas. Main topics included are: (1) problems, i.e., the dearth of women in science professions; (2) solutions; (3) survey questions for measuring sex bias; (4) instructions for improving attitudes toward mathematics; (5) worksheets; (6) factors predicting college science major choice; (7) organizations; (8) resource media and material; (9) strategies for the future; and (10) selected bibliography (containing eight references). Some practical advice for teachers is included. (YP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Rose J. Arbanas

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

HANDBOOK FOR EDUCATORS

BEST COPY AVAILABLE

GIRLS + MATH + SCIENCE = CHOICES

A Handbook for Educators

Rose J. Arbanas, Project Director
Gayla R. Lindquist, Editor
Susan Umphrey, Illustrator

Calhoun Intermediate School District
17111 G Drive North
Marshall, Michigan 49068

We are grateful for the insight and assistance offered by
the **EDUCATORS HANDBOOK COMMITTEE:**

Doug Burger, Marshall M.S., Marshall
Sharon Ferris, Quincy M. S., Quincy
Joe Fisher, Bronson M. S., Bronson
Sharon Holcomb, Lakeview J.H.S., Battle Creek
Dennis Massingill, Battle Creek Central H.S.
Linda Smith, Legg M.S., Coldwater

1986 Discretionary Demonstration and Exemplary Grant
Elementary and Secondary Education for Economic Security Act (EESA)
Special Populations: Young Women
Awarded by the Michigan State Board of Education

4th Printing 3
1989

Women whose careers involve mathematics and science backgrounds form a conference panel which provides essential role-models.

Table of Contents

What's the Problem? 1

What's the Solution? 5

Survey Yourself 9

Instructions for Attitude Toward Math 13

Pencil Exercises 21

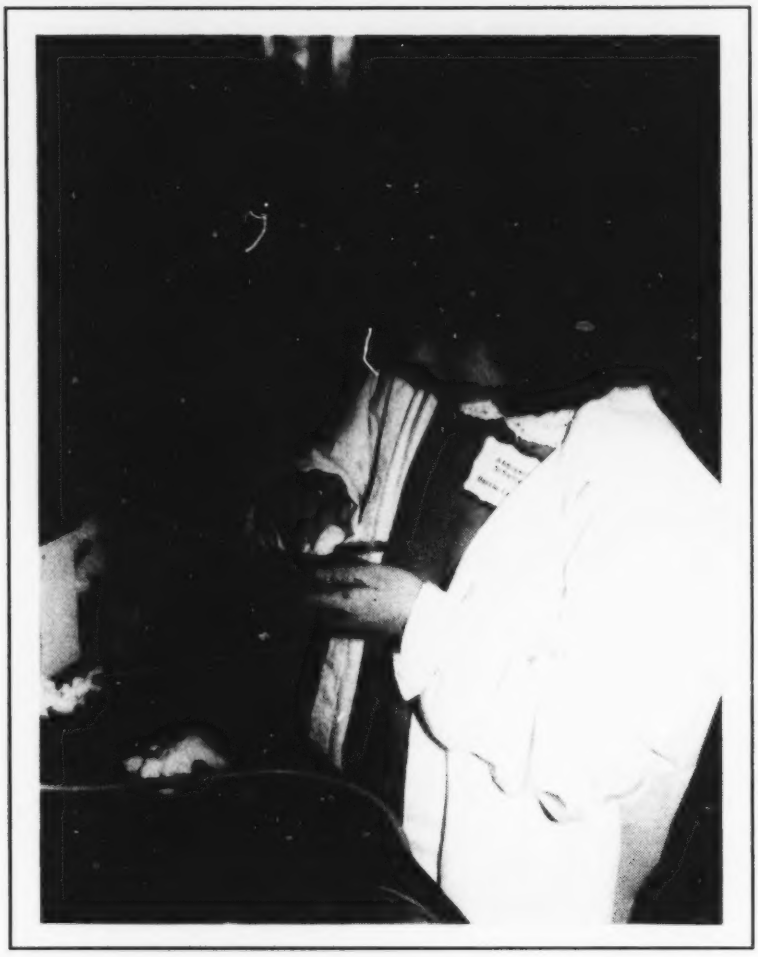
Why Do Students Major in Science or Mathematics? 29

Places to Write 30

Resource Media & Materials 32

Strategies for the Future 34

Selected Bibliography 35



Opportunities for lots of hands-on activities are important.

What's the Problem?

Have you, or has someone you know, ever said to a girl:

"You don't need to study any more mathematics."
"Engineering is a dirty/hard/man's field."
"You're too pretty to be a mathematician."
"Why would you ever want to study physics?"
"What's a nice girl like you doing in a MATH class?"

Perhaps you haven't sent these messages, but these are still the messages many girls are getting. Although women now earn half the bachelor's and master's degrees awarded in the United States each year, their areas of specialization tend to be in fields that:

- Have low status.
- Pay low salaries.
- Have traditionally been dominated by females.

In disciplines with strong scientific and technical requirements, women still make up less than five percent of the practicing engineers, and they still hold less than 14 percent of the doctoral degrees in mathematics and physical sciences.

Aren't We Wasting a Lot of Brain Power?

There are considerations other than money and status, of course - job satisfaction and opportunities for growth, for example. And if girls really do have some unique qualities from boys, shouldn't we take advantage of those qualities?

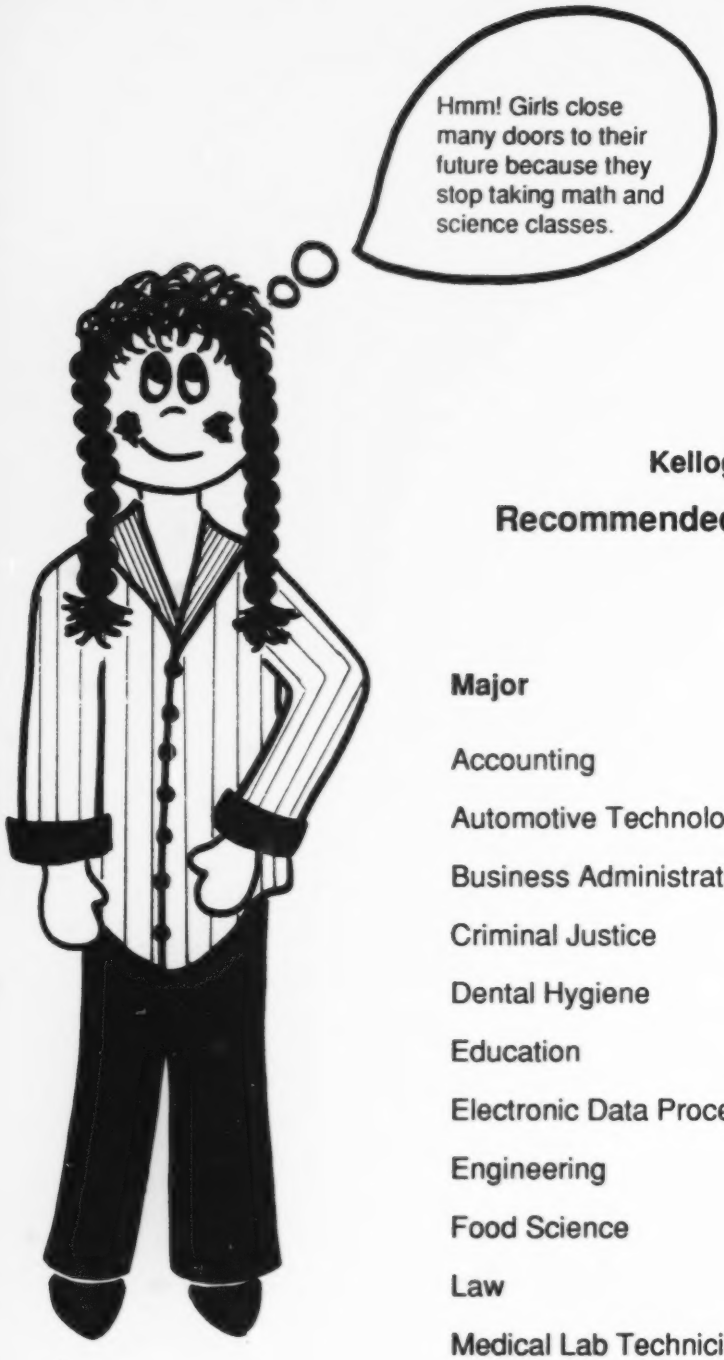
Are girls choosing - with their eyes wide open - careers with less pay and less prestige?

Girls start out in school testing higher in math and verbal skills than boys do. What other group starts out ahead - in reading, in writing, and even in math - and 12 years later finds itself left behind?

As boys and girls pass through junior high school, both girls and boys expect girls to do less well in math; the surprising point is that their decreased expectations precede, rather than follow, the decline in math achievement by girls. **SOMEBODY EXPECTS GIRLS TO FAIL BEFORE THEY ACTUALLY DO.**

GIRLS CLOSE MANY DOORS TO THEIR FUTURE BECAUSE THEY DISCONTINUE TAKING MATH CLASSES.

DO GIRLS REALLY GET LESS INTELLIGENT AS THEY GROW OLDER
OR
COULD WE BE DOING SOMETHING BETTER?

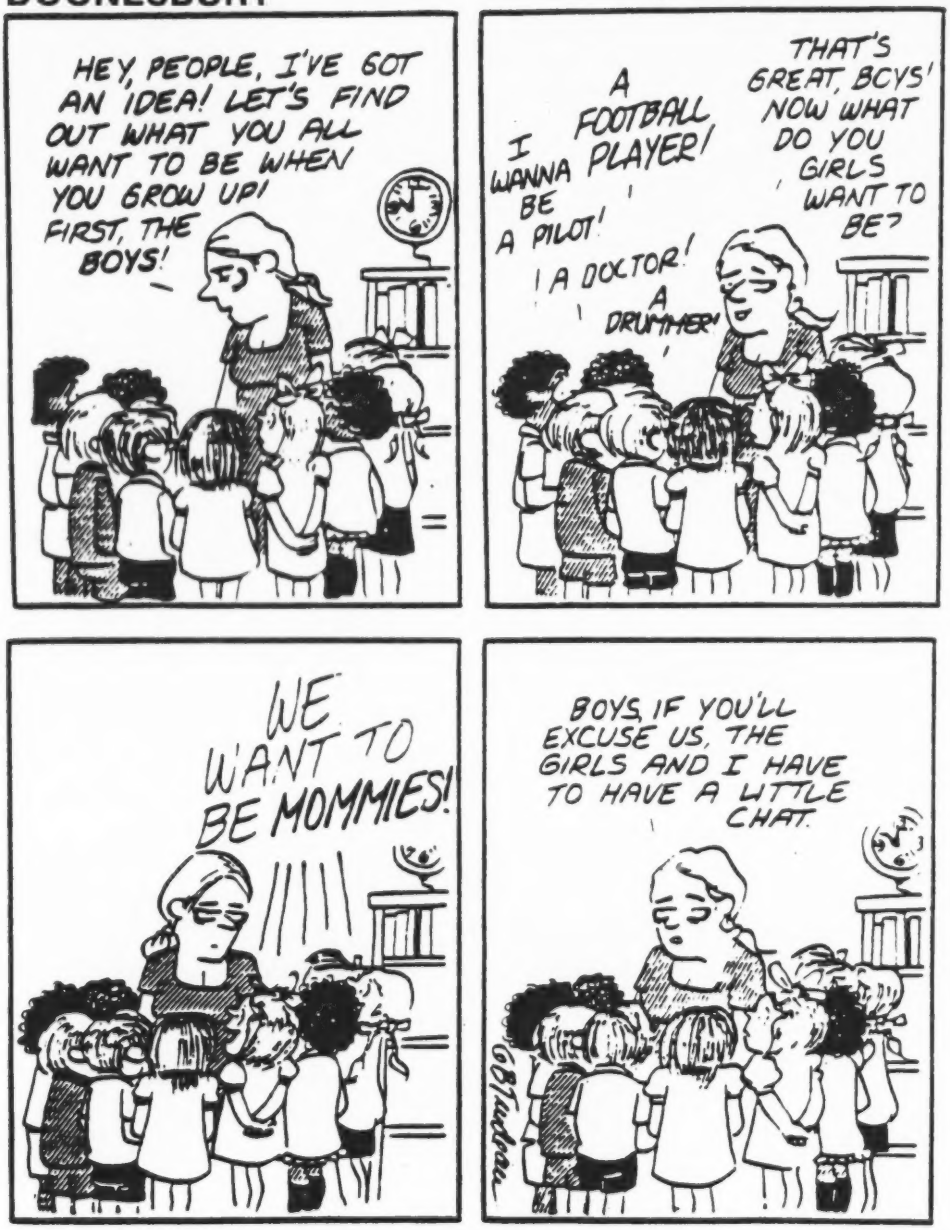


Kellogg Community College

Recommended High School Years of Study

Major	Mathematics	Science
Accounting	3	2
Automotive Technology	2	3
Business Administration	4	4
Criminal Justice	4	3
Dental Hygiene	2	2
Education	4	4
Electronic Data Processing	3	2
Engineering	4	3
Food Science	4	3
Law	3	2
Medical Lab Technician	3	3
Medicine	4	3
Pharmacy	4	3
Physical Therapy	3	3
Social Work	3	2
Veterinary Medicine	4	3

DOONESBURY **by Garry Trudeau**


HEY, PEOPLE, I'VE GOT AN IDEA! LET'S FIND OUT WHAT YOU ALL WANT TO BE WHEN YOU GROW UP! FIRST, THE BOYS!
I WANNA BE A PILOT!
A FOOTBALL PLAYER!
A DOCTOR!
A DRUMMER!
THAT'S GREAT, BOYS! NOW WHAT DO YOU GIRLS WANT TO BE?
WE WANT TO BE MOMMIES!
BOYS, IF YOU'LL EXCUSE US, THE GIRLS AND I HAVE TO HAVE A LITTLE CHAT.
GBTrudeau

DOONESBURY© 1973 G. B. Trudeau. Reprinted with permission of Universal Press Syndicate. All rights reserved.

What's the Solution?

The First Step in Solving the Problem Is to Recognize that There Is a Problem.

Next, we can try to:

• Believe in girls' reasoning abilities, and provide many opportunities for them to practice mathematical reasoning within other subject areas. Girls believe they succeed because of luck, not ability.

• Stress learning by cooperation rather than by competition. Is the "I win; you lose" situation the best learning environment for anyone? Use older girls to tutor and counsel younger ones; encourage classmates to teach each other.

• Start sooner to help girls having trouble. We are much more likely to offer remediation to boys than girls.

• Form special interest groups in computers, science and mathematics for girls.

• Design co-educational career development classes in which both sexes learn about career potentials for women.

• Expose boys and girls to role models of women in various careers; bring in visiting female scientists, mathematicians, engineers.

• Discuss nontraditional careers for women, including salaries for men and women, and schooling requirements.

• Arrange opportunities for girls to "shadow" a female professional for a day to see what her work entails. (Usually she will be very happy to accommodate your request. All you have to do is ask.)

• Recognize the fact that boys get more interaction (of all kinds) with the teacher.

• Help girls set long-term goals. (Not next week - how about five years from now?)

• Discuss the under-achievement factor among gifted females, and ask how they can combat it in themselves and others. Talk about peer pressure: "Is it smart for girls to play dumb?"

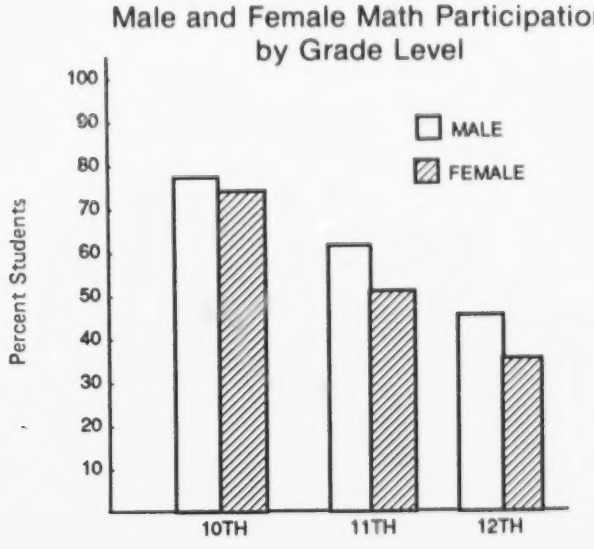
• Have students read biographies of famous women (MATH EQUALS: BIOGRAPHIES OF WOMEN MATHEMATICIANS AND RELATED ACTIVITIES, Addison Wesley, 1978.) Remember Sally Ride and Lillian Gilbreth (of Cheaper by the Dozen fame).

Michigan Project on Equal Education Rights studied enrollment patterns and found:

The Gender Gap in Math:

The data which most dramatically showed the difference in math education of girls and boys was the mathematics enrollment data given by grade level.

For the 80 districts supplying grade level enrollment data we found only 51% of the 11th grade girls and 36% of the 12th grade girls taking math, as compared to 61% of the 11th grade boys and 45% of the 12th grade boys. These figures do not take into account the level of difficulty of the math class taken.



Michigan PEER Study
Mathematics Enrollment 1981-82
(113 Districts)

We Can Continue to:

• Discourage sexist remarks and attitudes in the classroom, the lounge and the lunchroom. ("Hi , Honey!" We would never allow similar racial or ethnic slurs.)

• Boycott sexist classroom materials, and write to the publishers for their immediate correction. Have your boys and girls do the writing as a class assignment.

• Try substituting "she" for "he." (Research shows that when "he" is used to mean "everyone" or a "generic" person, both males and females hear "male.")

• Discuss sexist messages in the media. Talk about "Cosby," "Family Ties," commercials. Have your students look for nontraditional models for men and women. When you show a film depicting a male physician or meteorologist, ask, "Where are the women?"

• Advocate special classes and after-school enrichment opportunities for the talented; encourage field trips for everyone to places like Fisher Body, the Impressions 5 Museum in Lansing, the Museum of Science and Industry in Chicago.

• Listen to girls. Be interested in their hobbies and outside activities.

• Encourage girls to continue in math/science. Get pushy, "At least give it a try!" Let girls know that it is better to get a B- in Algebra II or Advanced Chemistry than an A in _____. (You fill in the blank.)

• Let parents know of your concern. Try for a team ("We're in this together") approach.

• Encourage mothers to use computers. Learn to use one yourself, if you don't already know how, especially if you are female. Look for non-shoot'em-up computer software.

• Provide for different learning styles. Try to group ability levels together. Offer more opportunities for hands-on learning. Buy more manipulative materials.

• Keep from doing the work for them. Allow them to work without too much assistance; allow them to take risks without fear of failure. Don't evaluate everything they do.

TELL STUDENTS WHY MATH AND SCIENCE COURSES ARE VALUABLE AND USEFUL. (THEY MAY BELIEVE YOU.)

Survey Yourself

The following questionnaire is for you to respond to. There is no "answer sheet" because your feelings, your answers, not someone else's, are what matter here. If you make a copy of it first, you can pass on the questionnaire to a friend, a spouse, or (lots of copies) a class.

HOW DO YOU FEEL. . .?

PLEASE RESPOND TO EACH OF THE FOLLOWING ITEMS BY CIRCLING THE ANSWER CATEGORY WHICH BEST REPRESENTS YOUR OPINION.

SA = Strongly agree
A = Agree
N = Neutral
D = Disagree
SD = Strongly disagree

1. Few adults exhibit symptoms of math anxiety.	SA A N D SD
2. Girls in high school do better in English than in math; boys do better in math.	SA A N D SD
3. More girls perceive mathematics as likely to be helpful in earning a living than do boys.	SA A N D SD
4. Most schools offer "equal opportunity" in career preparation to both males and females.	SA A N D SD
5. Parents who dislike math can influence their children who, in turn, will also dislike math.	SA A N D SD

6.	Parents and teachers tend to emphasize math more for boys than for girls and are more unhappy with boys when they decide to stop taking math courses.	SA	A	N	D	SD
7.	"Success" is viewed by most females and males in our country as masculine-oriented and/or unfeminine.	SA	A	N	D	SD
8.	Boys "naturally" like math more than do girls.	SA	A	N	D	SD
9.	The continuous study of math through the twelfth grade assures students a wider range of career options when they leave high school.	SA	A	N	D	SD
10.	The more math courses a student elects to take in high school, the better his or her SAT scores are likely to be.	SA	A	N	D	SD
11.	Teachers' attitudes about math greatly influence students' attitudes about math.	SA	A	N	D	SD
12.	Boys have more natural ability to do math problems than girls have.	SA	A	N	D	SD
13.	Math teachers provide equal opportunities for boys and girls to respond to questions in the classroom.	SA	A	N	D	SD
14.	Girls tend to take more non-required math courses in high school than boys do.	SA	A	N	D	SD
15.	Society, in general, has long expected females to take little interest in mathematics.	SA	A	N	D	SD

Math Autobiography Questions

A. Think back to your math experience in *elementary school.* How did you feel about mathematics?

- Did you experience mostly success or difficulty in learning math?
- What did people say when you made a mistake in math, when you did very well?
- How did your interest and ability in math compare to other students' - male and female - in your class?
- How did your elementary school teacher feel about math? Did her/his feelings influence you in any way?

B. Now recall your math experience in *junior high school.* What were your feelings about math?

- In what way had they changed since elementary school?
- If your feelings about math changed, what might have prompted the change?
- Who helped you when you had difficulty with math?
- Were your experiences in math class different from your experiences in other subjects? How?
- How confident did you feel about your ability to learn math in junior high school?
- Were your math experiences in junior high school mostly successful?
- Did you experience any failure in math?
- How would you describe your feelings about math in junior high school?

C. What was your *high school* math experience like?

- Can you recall any strong feelings about math which occurred while you were in highschool?
- How much math did you study in high school?
- What were your reasons for choosing to study, or not to study, math?
- How did your parents, teachers, and counselors react to your decision regard ing math?
- How confident did you feel about your ability to learn math in high school?
- Did your friends take advanced math courses?
- How did students in your school feel about girls taking advanced math classes?

D. Did you study math in *college*?

- How did you feel about it?

E. What are your feelings about math *today*?

- If you were required to enroll in a math course tomorrow, how would you feel?
- If you had to select a single memorable experience in math, what would that experience be?
- Has math, or the avoidance of math, been a factor in any decisions you've made about the choice of a major, a job, a career?
- How confident do you feel about your ability to learn math?

Instructions for: "Attitude Toward Math"

There are no "norms" for the attitude scale which follows. We caution you that these are not achievement tests but attitude inventories which may be useful in helping you and your students to better understand their attitudes and feelings toward mathematics

Here are instructions you can give:

There are no right or wrong answers for the following group of statements. Please place the numbers which tell how you feel about each of the statements in the blanks preceding the statement. If you:

"Strongly Agree"	-	place a **5** in the blank
"Agree"	-	**4**
"Neutral" or "Undecided"	-	**3**
"Disagree"	-	**2**
"Strongly disagree"	-	**1**

To score the items: When the statement is preceded by a ± sign, give:

5 points	-	"Strongly agree"
4	-	"Agree"
3	-	"Neutral" or "Undecided"
2	-	"Disagree"
1	-	"Strongly disagree"

Reverse the scoring for items which are preceded by a ∓ sign (one point for "**strongly agree,**" two points for "**agree,**" etc.).

Of course, the discussion that evolves from this survey is more important than any "score."

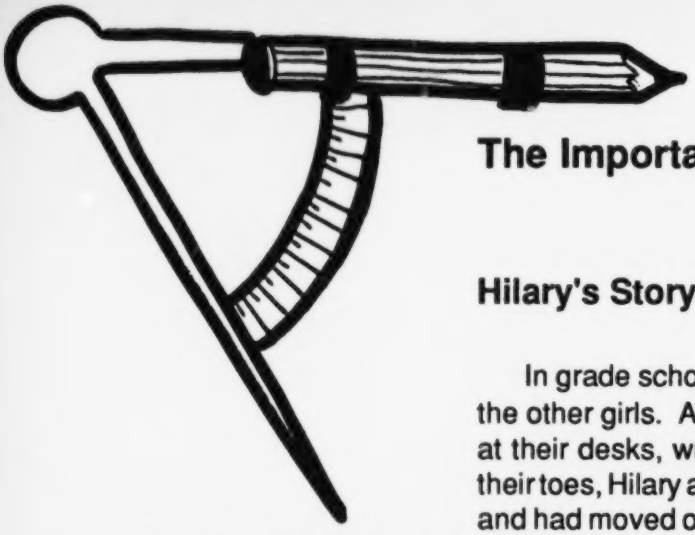
1. __+__ I am sure that I can learn mathematics.
2. __+__ Girls can do just as well as boys in mathematics.
3. __-__ I expect to have little use for mathematics when I get out of school.
4. __+__ I like math puzzles.
5. __+__ I'll need mathematics for my future work.
6. __-__ Math has been my worst subject.
7. __+__ When a problem arises that I can't immediately solve, I stick with it until I have the solution.
8. __+__ Women certainly are logical enough to do well in mathematics.
9. __-__ I don't understand how some people can spend so much time on math and seem to enjoy it.
10. __-__ I would have more faith in the answer to a math problem solved by a man than by a woman.

Attitude Toward Math

There are no right or wrong answers for the following group of statements. Please place the numbers which tell how you feel about each of the statements in the blanks preceding the statement. If you:

"Strongly Agree"	-	place a **5** in the blank
"Agree"	-	**4**
"Neutral" or "Undecided"	-	**3**
"Disagree"	-	**2**
"Strongly disagree"	-	**1**

1. _____ I am sure I can learn mathematics.
2. _____ Girls can do just as well as boys in mathematics.
3. _____ I expect to have little use for mathematics when I get out of school.
4. _____ I like math puzzles.
5. _____ I'll need mathematics for my future work.
6. _____ Math has been my worst subject.
7. _____ When a problem arises that I can't solve immediately, I stick with it until I have the solution.
8. _____ Women certainly are logical enough to do well in mathematics.
9. _____ I don't understand how some people can spend so much time on math and seem to enjoy it.
10. _____ I would have more faith in the answer to a math problem solved by a man than by a woman.



The Importance of Math

Hilary's Story

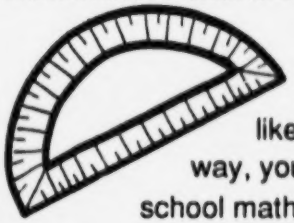
In grade school, Hilary was a whiz at math. So were many of the other girls. At times when many of the boys were squirming at their desks, wrinkling their foreheads, and trying to count on their toes, Hilary and the girls had already finished the assignment and had moved on to the extra credit questions and puzzles. Her parents hardly noticed when she brought home A's in math. It happened so often that they just took it for granted.

Then, sometime in junior high school, all that changed. Like her friends, Hilary seemed to lose interest in math. Her grades dropped, but she didn't really care. The boys, on the other hand, seemed to have finally caught on. They were taking all the math offered and doing well in it now.

What happened to cause this turnabout? Did the girls become dumb for some reason? Did the boys drain the girls' math ability and use it for their own, like some mad scientist in a bad horror movie? No, of course not. There isn't a logical explanation, but what happened to Hilary does happen frequently to young women. It has nothing to do with ability. If you had ability in grade school, you still have it. What you may have lost is the motivation to learn math. What you may have acquired is the notion that math is "unfeminine" or "for brains only." You may think, "No one wants to date girls who take trigonometry." If you do, that's silly.

You need to take math. Three years of high school math will give you more career options than almost any other subject. A great array of clerical jobs in banking, insurance, business and government need workers with math skills.

If you're planning to go to college, taking some math classes in high school is essential. A year of algebra and one of geometry is a bare minimum. If you have any interest in science or engineering, you ought to take trigonometry and calculus, too. Many colleges will not admit you without a solid math background. Most majors that prepare you for a specific, high-paying career require math, although the amount and kind may differ. The math an engineer or a chemist needs is different from that an economics or business major needs. In each case, the solid high school math foundation is the same. Whatever your major, one thing is certain. A knowledge of math helps you think analytically, which is an asset in any job. If you have no idea of the career you would like to pursue eventually, take math in high school to be safe. In this way, you will not eliminate potential majors or careers for lack of a high school math background.



Did You Know?

With math in her background a young woman graduating from high school can expect to earn $2,000-$4,000 more in her first entry-level job. Math is often the key to the nontraditional jobs that pay more and offer more upward mobility.

It is a myth that people good at math can instantly come up with the right answers or correct procedures.

The average yearly salary offered to a graduate with a 1988 Bachelor of Science Degree in industrial engineering was $35,010; with a Bachelor of Arts degree in social work, $16,350.

These high-paying jobs require some college math:

- Doctors
- Nurses
- Pharmacists
- All science-related jobs:
  - Engineers
  - Physicists
  - Geologists
  - Oceanographers
  - Architects
  - Accountants
  - Computer Programmers

Over half of the jobs which are expected to increase most in number of workers by 1995 require math skills.

Math is not a talent but a series of skills to be learned.

Mary Kay's Story

Mary Kay's friends scoffed at her interest in math and science. They said that you should just go to college to have fun and learn interesting things. Mary Kay thought differently, "I decided I wanted to be able to get a job that I'd like and that would support me just about anywhere in the country. So I went into pharmacology. It sounds boring to a lot of people, I know, but I love it. I've been working at the hospital for eight years now. I work with doctors and patients, and recently I started lecturing to nursing classes. I make more money than most women do, too. I feel bad that some of my old friends still haven't found jobs that they like. One of them, though, finally decided to start all over and is now in medical school. She's the one who was most against my studying pharmacology. Funny how things work out."

World of Work Quiz

True or False:

_____ 1. You have to like math to learn it.

_____ 2. Males like math better than females like math.

_____ 3. Males are more likely than females to continue taking mathematics because they are told it is a requirement for their future career choices.

4. The average male graduating from high school in 1989 can expect to work outside the home between:

a. 10 - 15 years
b. 15 - 25 years
c. 25 - 35 years
d. 35 - 45 years

5. The average female graduating from high school in 1989 can expect to work outside the home between:

a. 10-15 years
b. 15-25 years
c. 25-35 years
d. 35-45 years

6. In 1984 the percentage of women who worked because of economic need (self-supporting or husband earned less than $15,000) was:

a. 33%
b. 45%
c.. 56%
d. 66%

7. Married men with non-working wives and one or more children made up what percentage of all households in 1989:

a. 7%
b. 26%
c. 60%
d. 82%

8. Married men with non-working wives and one or more children made up what percentage of all households in 1955:

a. 7%
b. 26%
c. 60%
d. 82%

ANSWERS - WORLD OF WORK QUIZ

1. **False** - Success in math, like any other subject, is directly related to how much time you spend learning it.

   When students have difficulty with algebra in 9th grade, we allow them to stop taking mathematics classes. (If they have difficulty with English, we get them help or have them repeat the class. We know they must continue to take English because it is important to their future.)

2. **False** - Studies consistently indicate there are no significant differences in males and females liking of mathematics.

3. **True** - Parents, teachers, counselors and society in general send this message about the importance of math to the future of males more frequently than to females.

4. **d. 35 - 45 years**

5. **C. 25-35 years** - The gap between males and females continues to decrease. Females who remain single and those who marry but do not have children may expect to work the approximate number of years as males.

6. **d. 66%**

7. **c. 7%** - With some surveys indicating as low as four percent.

8. **a. 60%**

Source No. 4 and No. 5: Bureau of Labor Statistics, Worklife Estimates 1989.

Advising Students on Course Selection

Student Says	You Say
But I don't like math.	Math is becoming more and more important in all areas of work.
But I don't do well in math.	Most people, even those who go into math-related careers, were not straight-A students in math.
It'll hurt my grade-point average.	A well-rounded preparation is more important than your grade-point average. Not taking math will close the door to many careers.
I don't like the teacher.	We all have our preference in teachers. If you don't understand her/his explanation, there's a study group to help you. (Make sure that there isn't harassment going on in this class.)
I'm not going to need it anyway.	The average teenager in high school today will work for over 30 years, whether male or female. You'll lose out on higher pay if you don't have a math background.
It's boring.	One of the chief reasons students find math boring is that they lack confidence in their abilities. You seem to be able to do it. Now you have to convince yourself that you can do it.
My mother/sister/friend didn't need math.	Not everybody uses a lot of math, but more people are needing more math to do their work. You'll increase your chances of having more opportunities if you stay in math.
I feel dumb in math class.	It's awful to feel dumb. I bet you feel that way when you've run out of strategies for solving a problem. You could use a study group or some extra help. Do you have a list of problem-solving strategies that can help you keep at a tough problem?
I don't want to be a nuclear physicist or anything like that.	Do you know how much math you need to major in business? be a veterinarian? open your own store?
I'm going to get married and have babies.	Most women who are married need to work outside for financial reasons. Even if you find a millionaire, there's a chance you'll get divorced. Besides your kids won't do well in school if you don't have faith in education.
How do you know so much?	Be honest. Then point out that educators earn less than many people with technical degrees. Many educators have gone on to other careers. Also, teachers with math and science majors are in high demand throughout the nation.

Reducing Math Avoidance

Teachers can help reduce student math avoidance behaviors by demonstrating the following positive mathematics teaching practices:

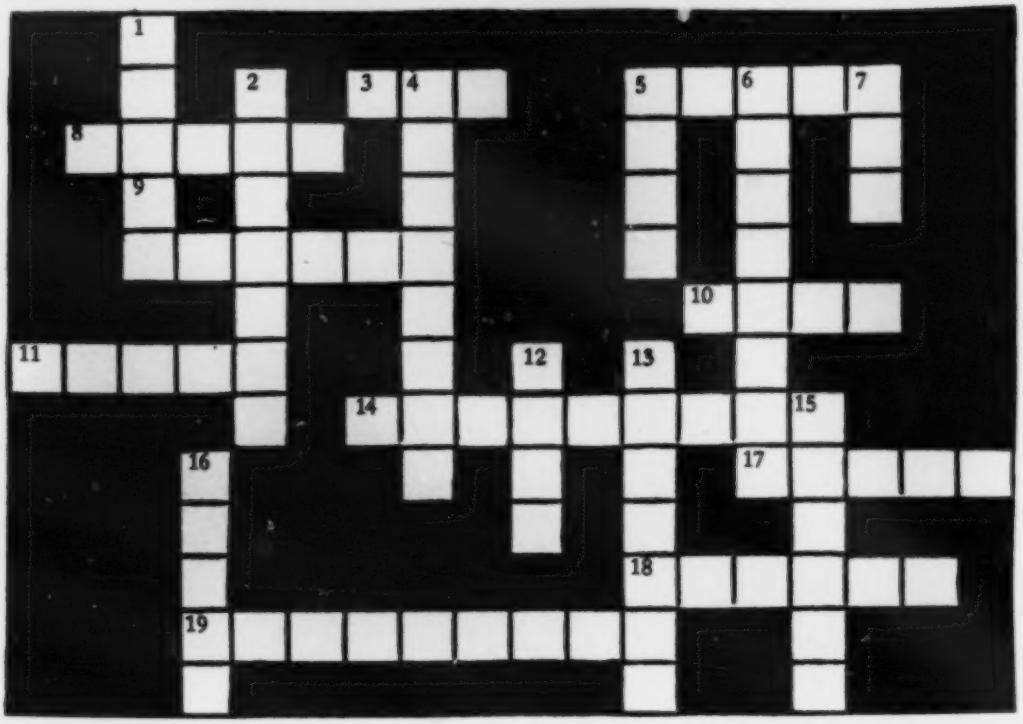
1. **Emphasize many correct ways to solve each problem. Encourage creativity.**
2. **Provide enough time for problem-solving.**
3. **Use drill assignments on a limited basis.**
4. **Assign work to meet individual needs.**
5. **Assign written homework only as needed.**
6. **Begin each year with testing to determine how much review of the past year's math curriculum is necessary.**
7. **Use the textbook as a resource not as the curriculum.**
8. **Correlate mathematics with real life situations.**
9. **Use mathematics-related problems, games and puzzles as a reward.**
10. **Use praise and reward for students who meet and exceed expectations.**
11. **Allow students to work together in small groups.**

Teachers should strive to develop creativity in mathematics instruction and relate classwork to real life situations. High teacher expectations for all students will promote interest and selection of mathematics and science education by greater numbers of students, particularly by female and minority students. Teachers' enthusiasm for mathematics can be contagious and can do much to overcome formerly poor students' experiences. Improvements in mathematics teaching practices can lead to an increase in selection of mathematics education and, therefore, increase career choices and opportunities for women.

Sentence Completion Exercise

1. When I need help with math, I usually ask. . .
2. I would expect a female mathematician to be . . .
3. I would expect a male mathematician to be . . .
4. Girls who enjoy math are. . .
5. Boys who enjoy math are. . .
6. When a boy fails a math quiz, it is usually because. . .
7. When a girl fails a math quiz, it is usually because. . .
8. Girls should be preparing for careers in . . .
9. Boys should be preparing for careers in . . .
10. When a daughter graduates from high school or college, her parents expect her to. . .
11. When a son graduates from high school or college, his parents expect him to. . .
12. In math classes, teachers think the boys should. . .
13. In math classes, teachers think the girls should. . .
14. When talking about math, counselors usually think that girls should. . .
15. When talking about math, counselors usually think that boys should. . .

Women Scientists Crossword Puzzle



ACROSS

3. After diving underwater and collecting many different plants, Sylvia Earle Meade found twenty- _____ new forms of ocean plants.

5. _____ are tiny insects which can jump great distances.

8. Kate Furbish collected every flower she could find in the state of _____.

9. One of the first women geographers was named Ellen Churchill _____.

10. Margaret _____ studied the habits and customs of several different people throughout the world.

11. _____ is a favorite food of whales.

14. People who study plants are called _____.

17. Barbara Crawford Johnson helped to train women for a first trip into _____ as astronauts.

18. Jane Goodall observed chimps while she lived in the jungles of _____.

19. The science of studying best ways to run a home is called home _____.

DOWN

1. Annie Jump Cannon and Marie Mitchell studied the _____.

2. Zoology is the study of _____.

4. Margaret Knight worked with tools to become a famous _____.

5. An aquarium is home to a _____.

6. Radium is one of the rare _____.

7. Solar energy is energy from the _____.

12. In the field of _____, Charlotte Scott was a great teacher and expert.

13. Tuberculosis is a _____.

15. Rachel Carson warned of the dangers of using chemicals carelessly in a book called Silent _____.

16. The scientist who uncovered the mysteries of the firefly was named Arda _____.

Where Have All the Scientists Gone?

The Soviet Union is far outstripping us in science education, and Japan, with half our population, is producing twice as many scientists. The number of undergraduate science majors has fallen by half since 1960, and in another 10 years the batch of home-grown scientists will have dwindled to crisis proportions. Half the 1,100 doctorates awarded in physics last year went to foreign nationals; in two years the same thing will be true in chemistry.

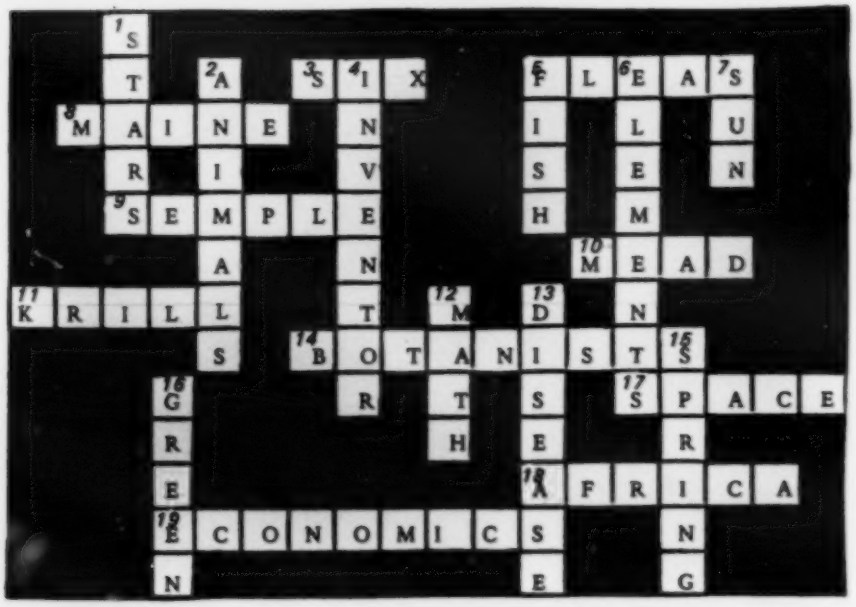
How did we wind up in such a mess? Robert Bottoms, president of DePauw University, Greencastle, Ind., says it sneaked up on us from a number of directions. The recent emphais on "vocationalism," the "glamorization of the MBA" and the explosive growth in "soft knowledge" fields - public relations, marketing and so on - have captured young people who might have gone into science.

During the last 15 years, after a spurt of post-Sputnik interest, "we have forgotten about science," Bottoms says. "Because the graduate schools were full, we thought we were doing okay. But they were full of foreign nationals." It is the failure to excite students about science that helps to account for the crisis, Bottoms believes.

"Advisers can tell students that the pursuit of science is a noble one, as generations since the Renaissance have believed. Colleges can stress through their admissions literature the beauties of the scientific method and experimentation - the beauty of the discipline required to understand a complex equation or a lengthy experimental process. We can tell students that majoring in science is not just a convenient way to enter medical school but an end in itself, a discipline as well worth pursuing as psychology and communications and economics," Bottoms says.

William Raspberry
Chicago Tribune, Nov. 28, 1987

Answer to Women Scientists Puzzle



Student Checklist

Please answer with (Y)es
(N)o or (S)ometimes

A. DO YOU LIKE:

_____ 1. to fix things?
_____ 2. to make things?
_____ 3. to be independent?
_____ 4. to create things?
_____ 5. to explore?
_____ 6. to learn?
_____ 7. to be challenged by new situations and ideas?
_____ 8. to do puzzles?
_____ 9. to solve problems?
_____ 10. to work out mathematical problems?
_____ 11. to tinker with or build mechanical things?
_____ 12. to play with numbers?
_____ 13. to work with details?
_____ 14. to attend and do the work in your mathematics courses?
_____ 15. to attend and do the work in your science courses?
_____ 16. to play or listen to music?

B. ARE YOU:

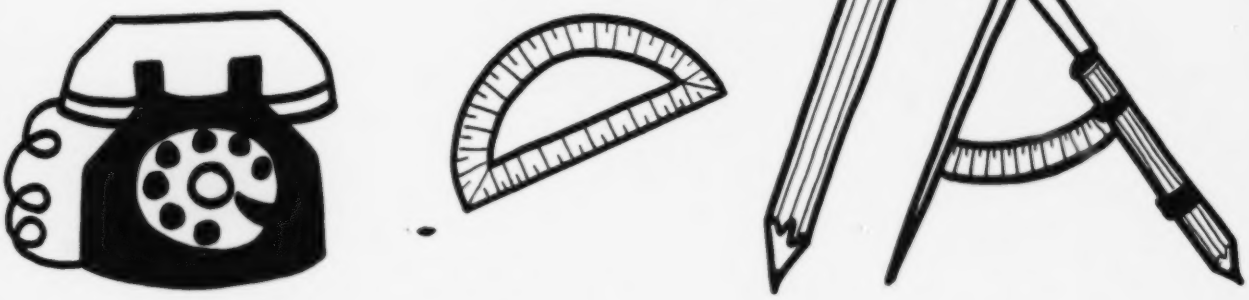
_____ 1. inquisitive?
_____ 2. persistent?
_____ 3. precise?
_____ 4. imaginative?
_____ 5. mechanical?
_____ 6. adept with your hands?
_____ 7. challenged by mathematical problems?
_____ 8. able to concentrate for long periods of time?

C. CAN YOU:

_____ 1. apply knowledge to unfamiliar situations?
_____ 2. stick with tasks or problems which may be time-consuming and/or difficult?
_____ 3. study effectively?
_____ 4. organize your time and work?
_____ 5. work independently?
_____ 6. communicate well with others?
_____ 7. express your ideas clearly?
_____ 8. write well?

The following is a classroom activity you might use as the basis for a sex-equity and careers discussion.

The Working World



"When I grow up, I want to be a _____ ." You can usually tell the sex of a person by the way he or she completes that sentence. Why? When you look at the working world today, most occupations are still dominated by one sex or the other. Below is a list of jobs. Read through it, and put an F by jobs usually held by women and an M by those jobs usually held by men. At this point, we hope you are saying to yourself, "I don't see jobs as either male or female." For this exercise though, consider how the world is today.

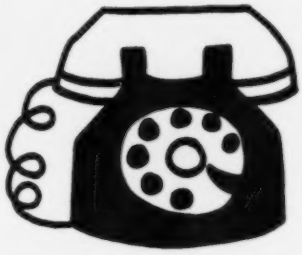
What do you see when you walk into a hospital? You see doctors, M, and nurses, F. Likewise, most secretaries are women. Put an F by secretary. When you walk into a bank, what do you see? It's tellers, F, and bank officers, M.

Keep in mind that, just because a pattern exists, there is no reason for you to assume that it is carved in stone. Changes are taking place in all fields.

_____	Architect	_____	Teacher
_____	Telephone installer	_____	Carpenter
_____	Engineer (Civil)	_____	Retail salesperson
_____	Clerk-typist	_____	Air traffic controller
_____	Bookkeeper	_____	Airplane mechanic
_____	Secretary	_____	Police officer
_____	Computer programmer	_____	Flight attendant/stewardess
_____	Dental assistant	_____	School principal
_____	Bank teller	_____	Nurse
_____	Accountant	_____	Surgeon
_____	Dentist	_____	Receptionist

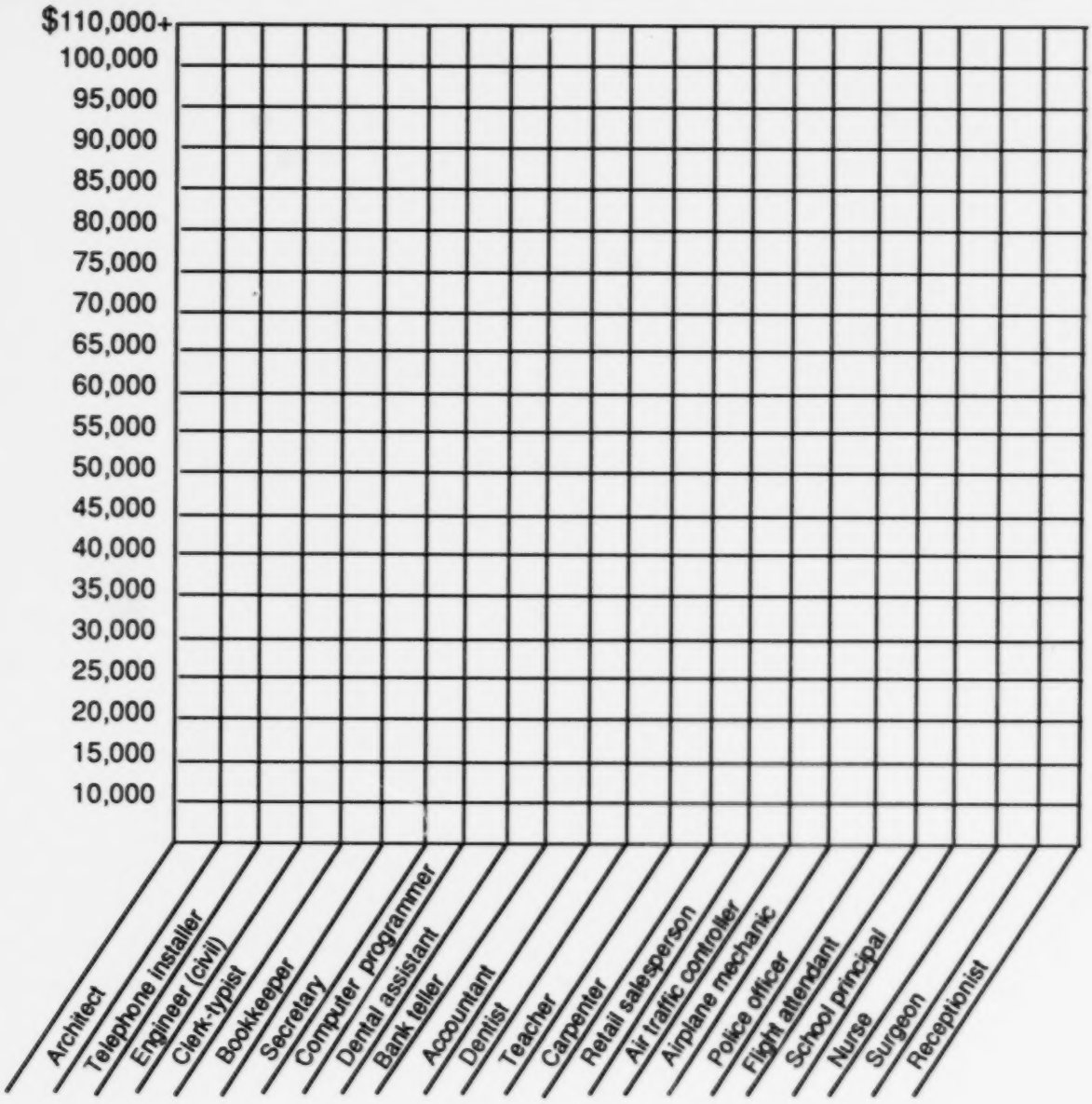
Now let's attach salaries to these jobs. The salaries given below are from the 1988 Jobs Rated Almanac, Les Krantz publisher and editor. Figures are rounded off to the nearest $1,000.

Using the figures listed, complete a graph of the salaries on the preceding page. Use a pen for each dot that represents a "woman's job" as identified by the symbol F. Use a pencil for each dot that represents a "man's job" as identified by the symbol M. Connect the pencil dots with pencil and the pen dots with pen. (Colored pens or pencils may be used instead of plain pens and pencils.)



AVERAGE ANNUAL SALARIES

Architect	$ 39,000
Telephone installer	$ 29,000
Engineer (civil)	$ 45,000
Clerk-typist	$ 16,000
Bookkeeper	$ 16,000
Secretary	$ 20,000
Computer programmer	$ 29,000
Dental assistant	$ 18,000
Bank teller	$ 12,000
Accountant	$ 35,000
Dentist	$ 65,000
Teacher	$ 26,000
Carpenter	$ 25,000
Retail salesperson	$ 16,000
Air traffic controller	$ 39,000
Airplane mechanic	$ 29,000
Police officer	$ 27,000
Flight attendant	$ 25,000
School principal	$ 43,000
Nurse	$ 26,000
Surgeon	$165,000
Receptionist	$ 13,000



What does the information on this graph tell you?

_____

_____

Mini-Research Activities
Careers in Science

Have the students write to professional associations or persons in your state to request brochures, pamphlets and written information about careers in science. Consider the following careers as possible areas of interest to your students:

pharmacist
nutritionist
chemical engineer
dietician
dentist
athletic trainer
nurse
zoo worker
geologist
science teacher

Once the information is received, there are a number of follow-up ideas you can use to expand students' awareness of careers in science. For example:

1. Compare the photographs of men and women in career fields.
2. Design a bulletin board.
3. Write want ads for these jobs.
4. Have students do a "poster talk."
5. Prepare a learning center.
6. Compare salaries in a chart form.
7. Write a true-false quiz for their parents.

Why Do Students Major in Science or Mathematics?

A study of factors associated with the decision to major in science or mathematics found that women students continue to view involvement in science as incompatible with marriage and family life, while their male counterparts did not view the goals of pursuing science and raising a family to be in conflict.

The report, based on a 1980 and 1982 study of high school seniors and college sophomores, shows that only 14 percent of the women in the top academic group had chosen a college science major compared with 40 percent of the men. Researchers Norma C. Ware of Radcliffe College, Maine, and Valerie Lee of the Educational Testing Service also found that encouragement by teachers and school counselors had a larger impact on the women students than the men. Their conclusion indicates that teachers and counselors can help young women feel confident about pursuing scientific careers by showing them how demanding careers and families can be effectively combined and by actively encouraging them to participate in science and math.

"Factors Predicting College Science Major Choice for Men and Women Students" is available for $2.00 from Norma Ware, Associate Dean, Fay House, Radcliffe College, 10 Garden St., Cambridge, MA 02138.

The MOST valuable resource in a classroom is the teacher's attention.

Places to Write

Write to these organizations to receive brochure copies that interest you.

American Chemical Society Career Services
1155 Sixteenth Street, N.W.
Washington, D.C. 20036
- Careers as a Chemical Technician
- A Career in Chemical Engineering
- A Career in Analytical Chemistry
- A Career in Biochemistry

American Meteorological Society
45 Balcon Street
Boston, MA 02108
- The Challenge of Meteorology

American Society for Microbiology
1913 Eye Street, N.W.
Washington, D.C. 20006
- Microbiology in Your Future
- American Society for Microbiology Fact Sheet
- Colleges and Universities Creating Degrees in Microbiology

American Statistical Association Careers in Statistics
Suite 640, 806 Fifteenth St., N.W.
Washington, D.C. 20005
-Careers for Women in Mathematics

The Center for Women's Services
Western Michigan University
Kalamazoo, MI 49007
- Women in Science Brochures available on: Psychology, geology, economics, computer science, biology, chemistry

Society of Women Engineers
United Engineering Center
Room 305
345 East 47th Street
New York, NY 10017
- Betsy and Robbie

The American Sociological Association
1722 N. Street, N.W.
Washington, D.C. 20036
- Careers in Sociology

Michigan Dept. of Education
Office for Sex Equity in Education
P. O. Box 30008
Lansing, MI 48909

Excellent materials to promote sex equity in education, available for K-12 teachers, counselors, and students.

EQUALS
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-1823

Teacher education programs and materials to attract and retain females and minority students in math.

Multiplying Options and Subtracting Bias
225 North Mills Street
University of Wisconsin, Madison
Madison, WI 53706

Excellent series of videotapes and workshop materials on women and mathematics for junior and senior high school students, teachers, counselors, parents; they present the case for keeping options open by continuing in mathematical study.

The Office of Opportunities in Science
American Association for the Advancement of Science
1776 Massachusetts Ave., N.W.
Washington, D.C. 20036

List of career opportunities in the sciences; reference bibliographies, etc.

The Committee on the Status of Women in Physics
American Physical Society
335 E. 45th Street
New York, NY 10017

Packet of three pamphlets to provide information for counselors, teachers, and students to encourage young women to consider science and engineering careers.

ASETS: Achieving Sex Equity Through Students
Wayne County Intermediate School District
Box 807
Wayne, MI 48184
(313) 467-1427

A student leadership program for encouraging students to explore and train for nontraditional entry to work opportunities. Part of the NETWORK PROJECT.

PEER Project
1112 13th St., N.W.
Washington, D.C. 20005
(202) 332-7337

A project that works to end school practices, policies, and attitudes that limit students' choices or keep them from learning the skills they will need for tomorrow's world.

Resources

Media & Materials for follow-up activities

1) When I Grow Up - 18 min. film. Shows clear differences very early in career aspirations of boys vs. girls. Also depicts differences in expectations of adults for boys vs. girls.

2) Making Points - 10 min. film. A very "pointed" film about sex stereotyping in our society. Features junior high age boys in role reversal.

3) Science: Women's Work - 25 min., 1/2" video tape. Shows a number of successful women working in scientific technical fields.

4) Math: A Four Letter Word - 20 min., 1/2" video tape. High school students and adults discuss their fear of mathematics and the importance of overcoming such fears.

5) Handbook for Parents - Designed to create an awareness of the important role parents have in whether or not their daughters pursue careers in scientific and technical fields. (Calhoun Intermediate School District)

6) Handbook for Planners - Designed to assist coordinators plan a conference for girls talented in math and science. (Calhoun Intermediate School District)

7) April 19, 1986 Conference - 10 min., 1/2" video tape. Depicts the conference activities and includes a strong message of encouragement to talented young women to pursue careers in math/science. (Calhoun Intermediate School District)

8) A Kit to Develop and Present a Math/Science Conference for Females in Middle School - Developed by: Betty Lee Ongley, Counselor, Portage Public Schools. (Office of Sex Equity, Michigan Department of Education)

Additional Resources

1) Downie D., Slesnick, T. and Stenmark, J., Math for Girls and Other Problem Solvers. University of California-Berkeley: 1981. Elementary school level curriculum activities. Emphasis on problem-solving activities: logic and patterns; breaking set; creative thinking, estimating, and observing; and spatial visualization.

2) Expanding Your Horizons in Science and Mathematics: A Handbook for Planners. Newton, MA: WEEA Publishing Center, 1980. Describes how to plan, conduct, and evaluate conferences to increase young women's interest in mathematics and science.

3) Fraser, Sherry, et al. SPACES: Solving Problems of Access to Careers in Engineering and Science. Palo Alto, CA: Dale Seymour Publications, 1982. Activities for students in grades 4-10, about scientific careers, problem-solving skills, attitudes toward math, spatial visualization skills, and work with mechanical tools.

4) How High the Sky? How Far the Moon? An Educational Program for Girls and Women in Math and Science. Newton, MA: WEEA Publishing Center, 1982. Short exercises for K-12 students on problem-solving skills and career information.

5) Kerr, Barbara. Smart Girls, Gifted Women. Ohio Psychology Publishing, Columbus, OH, 1985. An examination of the specialized needs of bright girls with recommendations to parents and teachers from preschool through professional schools.

6) MATHCO, developed by the Southwest Center for Human Relations Studies at the University of Oklahoma, Norman, OK. Helps girls in the middle grades feel competent about their ability to work with numbers, thus reducing anxiety. Program materials include posters, sound filmstrips, in-service manual, and teachers guides.

7) Skolnick, J., et al. How to Encourage Girls in Math and Science: Strategies for Parents and Educators. Englewood Cliffs, NJ: Prentice-Hall, 1982.

Strategies for the Future

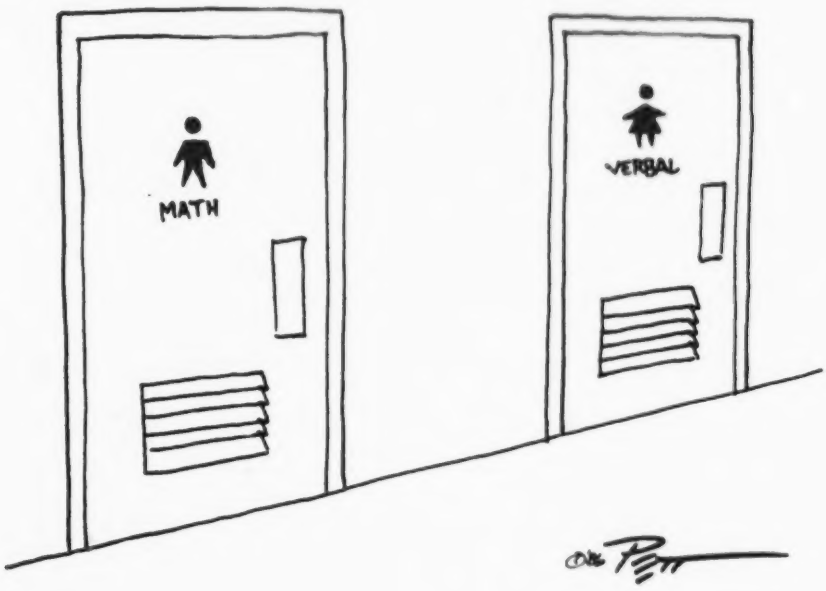
I'm going to follow up on three activities from this handbook:

1. _____

2. _____

3. _____

Pett Peeves by Joel Pett



Phi Delta Kappan Magazine
Reprinted by permission.

Selected Bibliography

Bureau of Labor Statistics, Worklife Estimates, 1989.

CHOICES: A Teen Woman's Journal for Self-Awareness and Personal Planning, Bingham, Edmondson and Stryker.

Collegiate Employment Institute Newsletter, Michigan State University, October 15, 1987.

Downie, D., Slesnick, T. and Stenmark, J.K., Math for Girls and Other Problem Solvers, EQUALS, Math/Science Network, Lawrence Hall of Science, University of California.

Kellogg Community College Admissions Manual, 1986.

Multiplying Options and Subtracting BIAS, An Intervention Program Designated to Eliminate Sexism from Mathematics Education, School of Education, University of Wisconsin, Madison, 1981.

Project on the Status and Education of Women - Association of American Colleges, Vol. 16, No. 1., Summer 1986.

Shapiro, Robert J. and Walsh, Maureen, "The Great Jobs Mismatch," U. S. News & World Report, Sept. 7, 1987.